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A NEW *EULIMNADIA* FROM THE RICE FIELDS OF ARKANSAS  
WITH A KEY TO THE AMERICAN SPECIES OF THE GENUS  
(CONCHOSTRACA, LIMNADIIDAE)

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During the course of studying mosquito larvae in the rice fields near Stuttgart, Arkansas, Dr. F. E. Whitehead, Professor of Entomology at the University of Arkansas, encountered numerous specimens of a conchostracan phyllopod which were forwarded to the writer for determination. This, a new species, represents the second of the genus *Eulimnadia* to be collected in these rice fields by Dr. Whitehead. The other species, *E. alineata* Mattox, was collected near Stuttgart in August 1948 and again in June 1949. This presents an interesting ecological situation with two so different species occurring in the same region and in the same ecological niche. The present species is radically different from *alineata*. The name *Eulimnadia oryzae* is here proposed for this new species. The specific name refers to *Oryza*, the generic name of the rice plant.

*EULIMNADIA ORYZAE, sp. nov.*

*Male.*—With the characters of the genus (Packard, 1883, and Daday, 1926). The bivalved shell is practically colorless, transparent, and elongate-oval (fig. 1). The dorsal margin is only slightly rounded with the highest elevation at the umbo approximately one-third the length from the anterior margin. The ventral margin is regularly rounded, the posterior end is more elongate than the anterior. The length of the adult shell averages 6.8 mm with an average height of 4.2 mm. The variations in the type lot are 7.5 by 4.5 mm to 6.3 by 3.8 mm. The lines of growth vary in number from 10 to 12, and are usually crowded.

The head possesses the typical pyriform frontal organ which is located near the base of the eye protuberance (fig. 6). The front is moderately concave, the greatest concavity just above the ocellus; the rostrum is not greatly extended. The head is held in a position such as to place the eye protuberance directly forward; the head gives the impression of being quite small, much smaller than that of the female. The scape of the second antennae is very elongate, one half the length of the scape extends beyond the tip of the rostrum. The flagella of the second antennae are variously spined (not figured) and have nine segments each, the two flagella are of approximately the same length. The first antennae extend to the third segment of the second antennae flagella. The first antennae possess 12 to 15 dorsal sensory papillae.

The body bears 18 pairs of swimming appendages; the first and second are modified into the typical gnathopods. The two segments of the digitiform sixth endite of the first gnathopod are unequal, the

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distal segment is approximately three times the length of the basal segment (fig 4). The distal segment of the more elongate sixth endite of the second gnathopod is approximately twice the length of the basal segment (fig. 5). There is a very conspicuous notch at the base of the "thumb" of the fourth endite on both the first and second gnathopod. The posterior 9 or 10 body segments bear mid-dorsal spines.

The telson is elongate, rhomboid in outline, the ventral margin only slightly more than one half the entire length of the dorsal spined margin (fig. 3). The dorsal ridges of the telson bear from 14 to 20 spines; 15 is the average number. The terminal telson claws (cercopods) are elongate and tapered, extending posteriorly and are longer than the dorsal margin of the telson. The dorsal forked filament arises between the third and fourth pair of telson spines.

*Female*.—The female shell (fig. 2) is similar to the male but much more ovate in outline. The dorsal margin is much more convex than in the male with the greatest height approximately one-third the distance from the anterior end. There is a slight concavity on the posterior portion of the dorsal margin. The average size of the adult female shell is 8.0 mm in length by 5.4 mm in height. The number of lines of growth averages 11, with a variation of 9 to 12 in the adult (egg bearing) females.

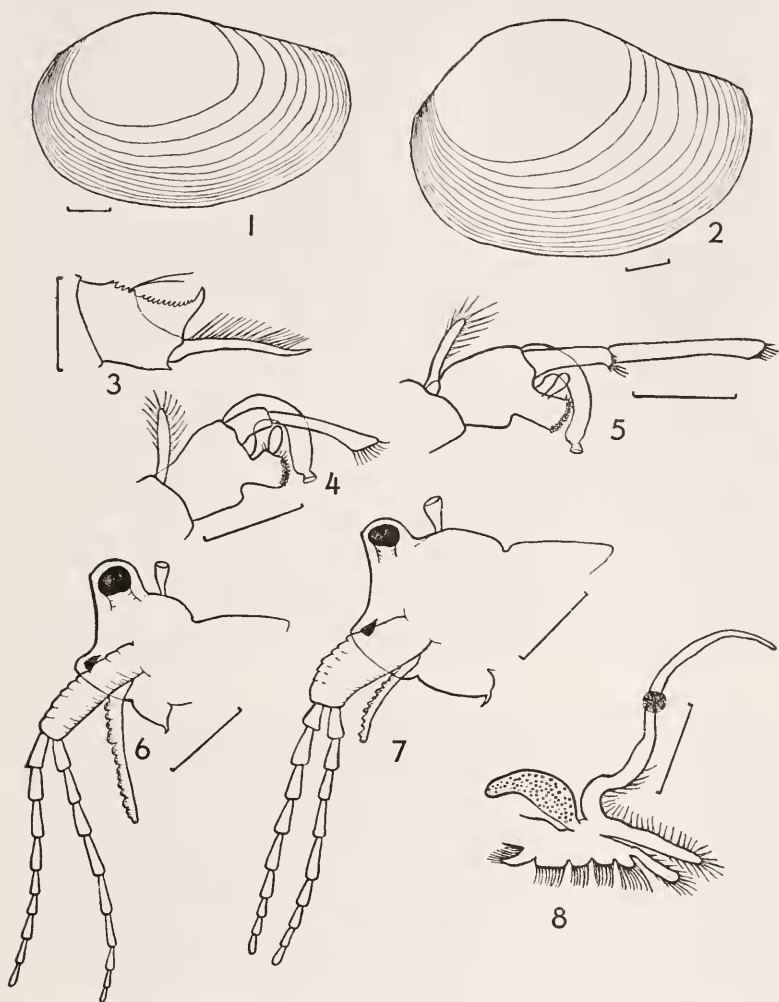
The front of the head is evenly and shallowly concave with a less pronounced rostrum than the male (fig. 7). In general outline the head of the female is much larger and more quadrate than the male. The second antennae are similar to those of the male. The first antennae are much shorter than in the male extending only to the first segment of the second antennal flagella. The occipital notch, as in the male, is very conspicuous.

The 18 pairs of swimming legs are unspecialized except for the elongated ovigerous epipodites of the ninth and tenth pairs. This epipodite is 2.5 times longer than the exopodite on the tenth pair (fig. 8). The dorsal body spines and the telson are similar to those of the male.

*Type locality*.—Rice fields at Stuttgart, Arkansas County, Arkansas.

*Types*.—Holotype, male, U.S.N.M. No. 96032; paratypes, both sexes, U.S.N.M. No. 96033; and in writer's collection.

*Remarks*.—*Eulimnadia oryzae* seems to be closely related to the eastern species *E. ventricosa* Mattox (1953), which is known from Virginia, Maryland, and Georgia. The shell of male *oryzae* is more elongate in outline and more attenuated posteriorly. The shell of females is not as full or elevated as in *ventricosa*; the length-height ratio of 1.5:1 as against 1.3:1 for *ventricosa*. The concavity on the posterior slope of *oryzae* is more pronounced than in *ventricosa*. The absence of color in the shell is distinctive for *oryzae*. The scape of the second antennae is longer in *oryzae*; the first antennae are proportionately shorter; the front is less concave; the telson is more elongate, and the cercopods longer in *oryzae* than in *ventricosa*. The basal segment of the sixth endite on the



Figures 1-8. *Eulimnadia oryzae*, sp. nov. 1. Shell of male; 2. Shell of female; 3. Telson; 4. First gnathopod of male; 5. Second gnathopod of male; 6. Profile of head of male; 7. Head of female; 8. Tenth swimming leg of female with egg on ovigerous epipodite. Scale lines for figures 4 and 5 equal 0.5 mm; all others are 1.0 mm.

first gnathopod of *oryzae* is proportionately shorter; the terminal segment of the sixth endite of the second gnathopod is proportionately longer than in *ventricosa*. The epipodite of the tenth leg of the female in *oryzae* is 2.5 longer than the exopodite, in *ventricosa* this proportion is less than 2.0. The number of growth lines on the shell and the number of telson spines are similar in *oryzae* and *ventricosa*, characters which separate these species from other North American forms. *E. alineata*, which has been taken from the rice fields in this same region, is smaller in size and is distinctive in lacking growth lines on the shell.

This species is based on one collection containing seven male and 33 female individuals taken on June 30, 1953 by Prof. F. E. Whitehead. Dr. Whitehead has indicated that these animals were so abundant that he believed there were actually thousands of them in a single cubic foot. The ecological notes, provided by Dr. Whitehead, in regard to the occurrence of these animals are worthy of note.

The rice fields typically are plowed in early spring and drilled to rice in April or May. Three to five weeks later, or when the rice is four to eight inches tall, the fields are flooded. After three to four weeks the fields are drained for the control of the rice water weevil. When the soil has become dry they are again flooded and kept under water until a week or ten days before harvest. The phyllopods occur in both the first and second flooding, but it is two or three weeks following the second flooding that they are most frequently extremely numerous. This is another indication of the rapid rate of development found in this group. *E. diversa* Mattox (1937) was shown to mature in 14 days.

Another interesting observation made by Dr. Whitehead indicates an unexpected resistance of these animals to insecticides. During field experiments a number of chlorinated hydrocarbon insecticides gave almost complete control of the mosquito larvae and produced a high mortality among other aquatic invertebrates present. However, without definite quantitative data it was observed that even at the higher strengths of insecticides there was an extremely low mortality among the phyllopods. These observations suggest some unknown physiological resistance possessed by *Eulimnadia* and possibly by other members of the order. To the best of the writer's knowledge the Conchostraca have not been extensively studied so far as physiological properties are concerned.

#### THE NORTH AMERICAN SPECIES OF *EULIMNADIA*

The genus *Eulimnadia* was proposed by Packard (1874) in order to separate this genus from *Limnadia* Brongniart 1820, the other member of the family Limnadiidae. This family is comprised of conchostracan phyllopods, those with a bivalve shell, possessing a pyriform, pediculated frontal organ on the mid dorsal surface of the head. The 18 pairs of trunk appendages, the conspicuous ventral spine on the telson at the base of the cercopods, and the second antennae flagella with 9 segments are the distinctive characters of the *Eulimnadia*. These charac-

ters were established by Daday in his monograph of the conchostracans in 1926.

The various *Eulimnadia*, as well as most of the conchostracans, usually appear in temporary pools during the warm months of the year. Some collections have been made in very small pools of rain water that appeared and dried up within two weeks. Many of the species of this genus are known only from their type localities indicating a very restricted range. Other species seem to be more widely dispersed. Members of this genus do not attain large size; all are less than 10 mm in shell length; most average 5 or 6 mm.

The morphological characters most used in separating the species are: the lines of growth on the shell; the size and shape of the shell; the telson spination; the form of the head; the male gnathopods, and the relative lengths of the antennae. The following is a key to the known species of the genus *Eulimnadia* found in North America. This key is intended only for sexually mature individuals. Maturity is judged on the basis of the presence of gravid females carrying egg masses on the modified epipodites of the ninth and tenth legs.

#### KEY TO THE GENUS *EULIMNADIA* OF NORTH AMERICA

1. Shell with lines of growth ..... 2  
 Shell with no lines of growth; 4.2 by 2.6 mm average; 9 to 12 telson spines; forked filament of telson between spines 3 and 4. .... *Eulimnadia alineata* Mattox 1953  
 Known only from rice fields at Stuttgart, Arkansas.
  2. Shell with one to four lines of growth; elongate, not strongly convex dorsally ..... 3  
 Shell of females with 5 to 12 growth lines; usually ovate and convex dorsally ..... 7
  3. Telson with 9 or 10 dorsal spines ..... 4  
 Telson with 12 to 16 dorsal spines ..... 5
  4. Shell 5 to 6 mm long by 3 to 4 mm wide; one to four growth lines; rostrum rounded; forked filament arises between telson spines 3 and 4. ....  
 ..... *Eulimnadia antillarum* (Baird 1852)  
 Has been taken in Louisiana and Mexico.
- Shell 4.3 by 2.5 mm average; one to four growth lines; rostrum pointed; first antennae extend to fifth segment of second antennae in male; forked filament arises between telson spines 2 and 3. .... *Eulimnadia francesae* Mattox 1953  
 From pools on Bear Island, Potomac River, Montgomery Co., Maryland.

5. Shell normally with two growth lines; shell of males averages 4.2 by 2.5 mm; front of head slightly convex; first antennae of male extend to fourth segment of second antennae; forked filament of telson between spines 3 and 4. ----- *Eulimnadia diversa* Mattox 1937  
Has been found only at Urbana, Illinois.
- Shell with three or four lines of growth; 6 to 7.5 mm in length ----- 6
6. Telson with 12 dorsal spines; forked filament arising between telson spines 1 and 2; rostrum not pointed and inflected; shell size average 6.2 by 3.8 mm; first antennae of male do not extend beyond scape of the second antennae. ----- *Eulimnadia agassizii* Packard 1874  
Known only from Penikese Island, Massachusetts.
- Telson with 16 dorsal spines, forked filament arising between spines 6 and 7; rostrum strongly pointed and inflected; males shell size average 7.3 by 4.3 mm; first antennae of male extend to fourth segment of second antennae. ----- *Eulimnadia inflecta* Mattox 1939  
Found at Prophetsown, Illinois, and Athens, Ohio.
7. Female with five lines of growth; mature size less than 8 mm in length ----- 8  
Lines of growth 7 to 12; mature size more than 8 mm ----- 9
8. Shell size averages 5 by 3 mm; 7 to 9 telson spines; male first antennae slightly longer than those of female; rostrum of male extended and sharply pointed. ----- *Eulimnadia antlei* Mackin 1940  
Taken at three localities in Oklahoma.
- Shell size averages 7 by 4 mm; telson with 16 to 20 spines; male first antennae extend to third segment of second antennae, in female shorter; rostrum rounded. ----- *Eulimnadia texana* Packard 1871  
Widely distributed in Texas, Kansas, Nebraska, and Oklahoma.
9. Male first antennae extend beyond scape of second antennae; forked filament of telson arises between spines 3 and 4. ----- 10

Male first antennae extend only to end of scape of second antennae; forked filament of telson arising between spines 5 and 6; 14 pairs of telson spines; average of 10 growth lines; shell size averages 8.5 by 6 mm

.....*Eulimnadia stoningtonensis* Berry 1926

Has been found only at Stonington, Connecticut.

10. Male first antennae extend to second segment of second antennae; 14 to 20 pairs of telson spines; average size of shell 8.1 by 5.5 mm; females have an average of seven growth lines; rostrum of male not attenuated anteriorly. ....*Eulimnadia thompsoni* Mattox 1939

Found in pools on an island in the Illinois River at Ottawa, Illinois.

- Male first antennae extend to third segment of second antennae; 10 to 12 growth lines. ....11

11. The male rostrum is attenuated to a sharp point, slightly inflected, front concave; shell very ventricose; shell length-height ratio 1.3:1; telson cercopod length same as dorsal margin of telson; 14 to 16 dorsal telson spines; second antennal scape extends to tip of rostrum. ....*Eulimnadia ventricosa* Mattox 1953

Taken at several localities in Maryland, Virginia, and Georgia.

- The male rostrum pointed but not greatly inflected; front slightly concave near rostral base; the occipital notch is conspicuous; growth lines crowded; shell length-height ratio 1.5:1; telson cercopods longer than dorsal telson margin; 14 to 20 dorsal telson spines; telson elongate; second antennal scape extends one-half length beyond rostrum. ....*Eulimnadia oryzae* sp. nov.

From ricefields at Stuttgart, Arkansas.

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